# 3.3.5 Spatial and Temporal Extent of Fogs

# 3.3.4 Vertical Structure of Relative Humidity

Don Lehrman
Liz Niccum
*Technical & Business Systems, Inc.*



T&B Systems

# Spatial and Temporal Extent of Fogs

## Sources of Information/Data

### Satellite Pictures

- Good for spatial extent but not temporal
- Not obtained during field study

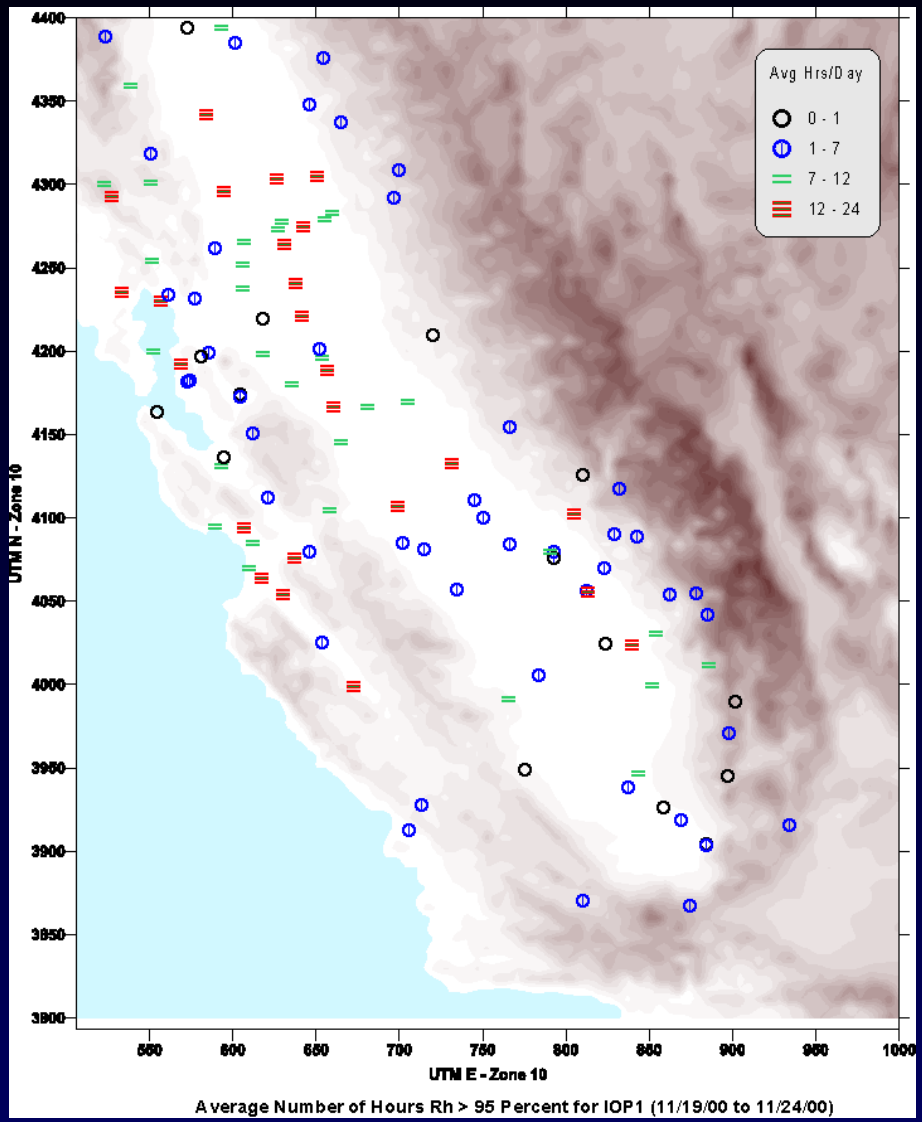
### Airport Observations (ASOS)

- Good for temporal extent at only few locations

### Relative Humidity Measurements

- Over 200 surface monitoring sites reporting hourly
- Used >95% RH to infer the presence of fog

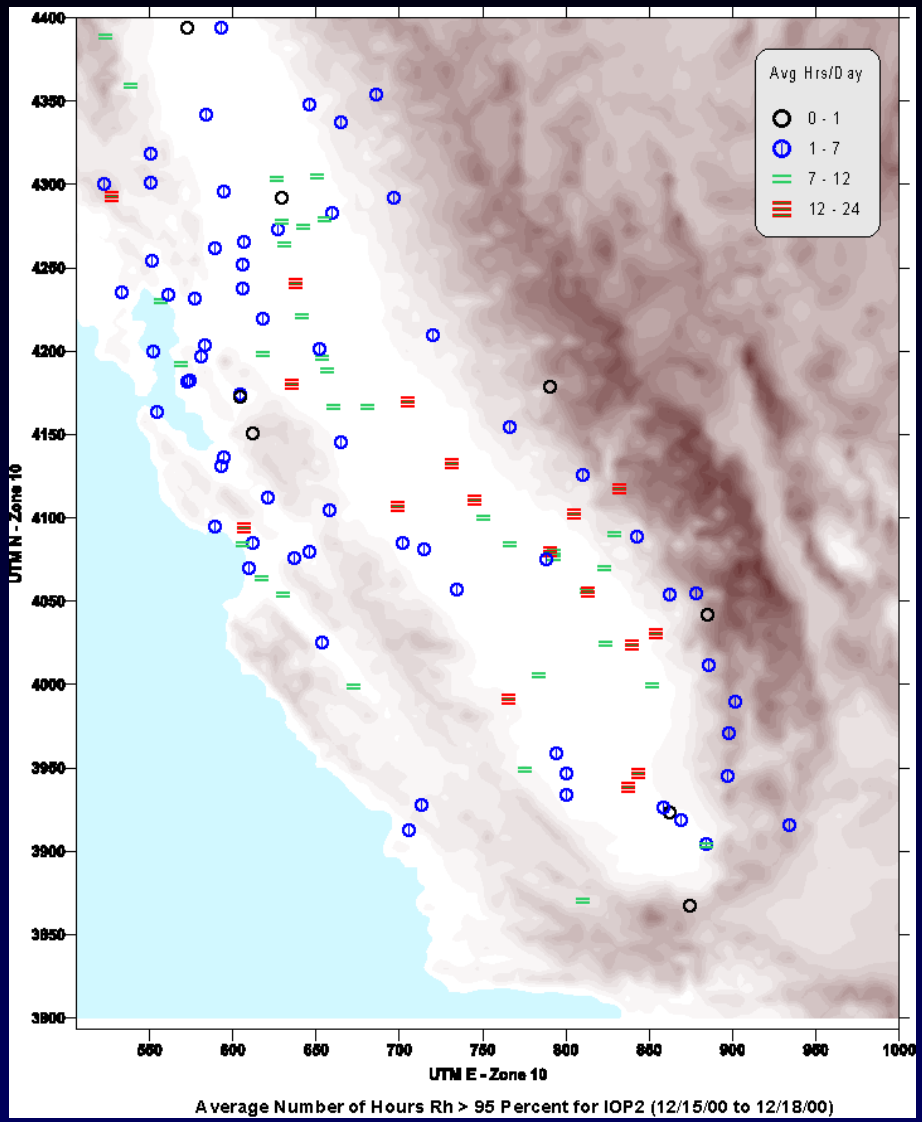
# IOP 1 – November 19-24, 2000
# Number of Hours RH > 95 Percent






T&B Systems

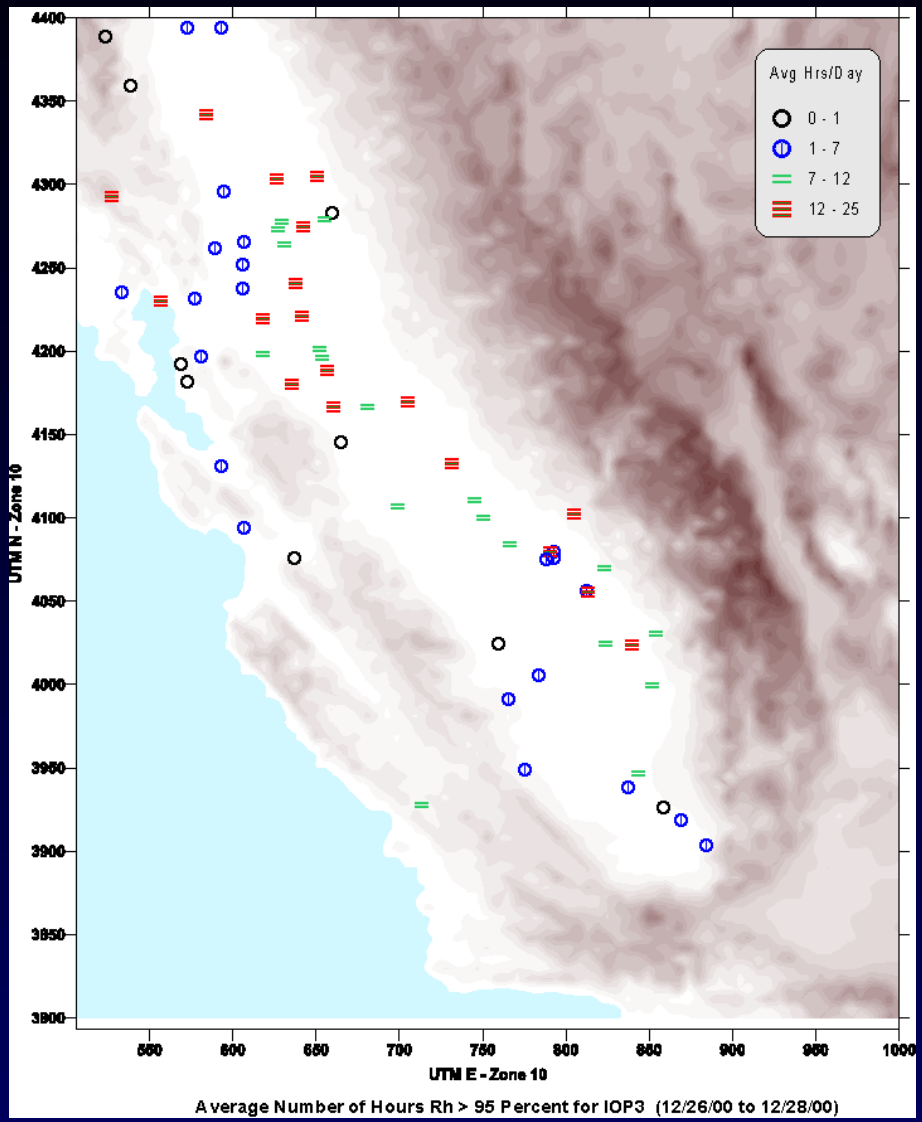
# IOP 2 – December 15-18, 2000
# Number of Hours RH > 95 Percent






T&B Systems

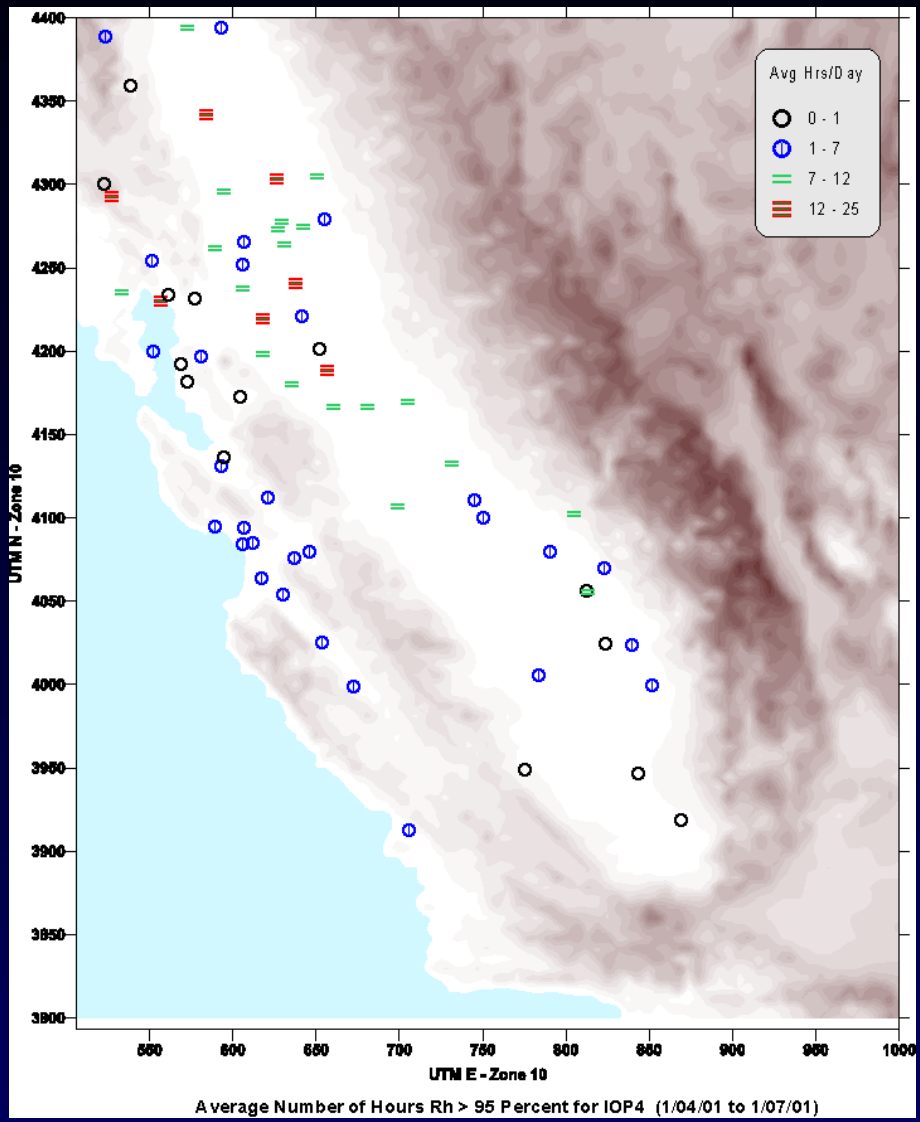
# IOP 3 – December 26-28, 2000
# Number of Hours RH > 95 Percent






T&B Systems

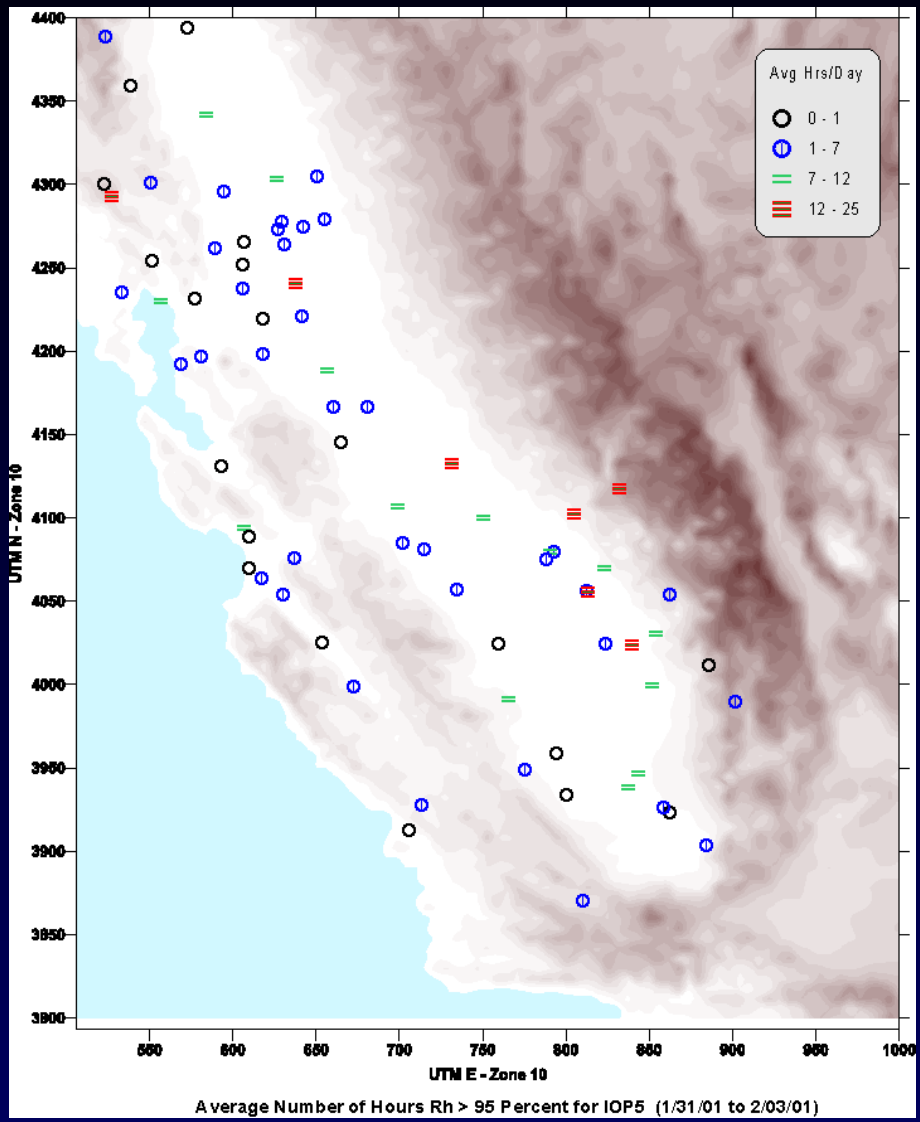
# IOP 4 – January 4-7, 2001
# Number of Hours RH > 95 Percent






T&B Systems

# IOP 5 – January 31-February 3, 2001
# Number of Hours RH > 95 Percent



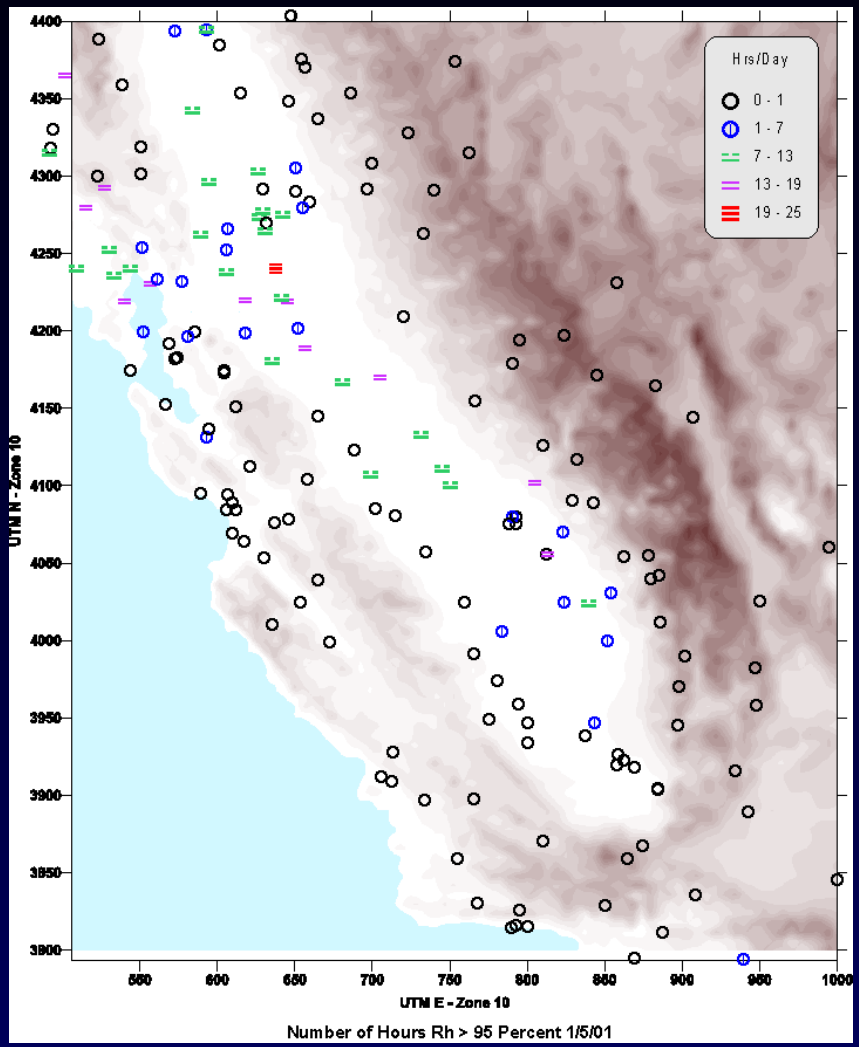


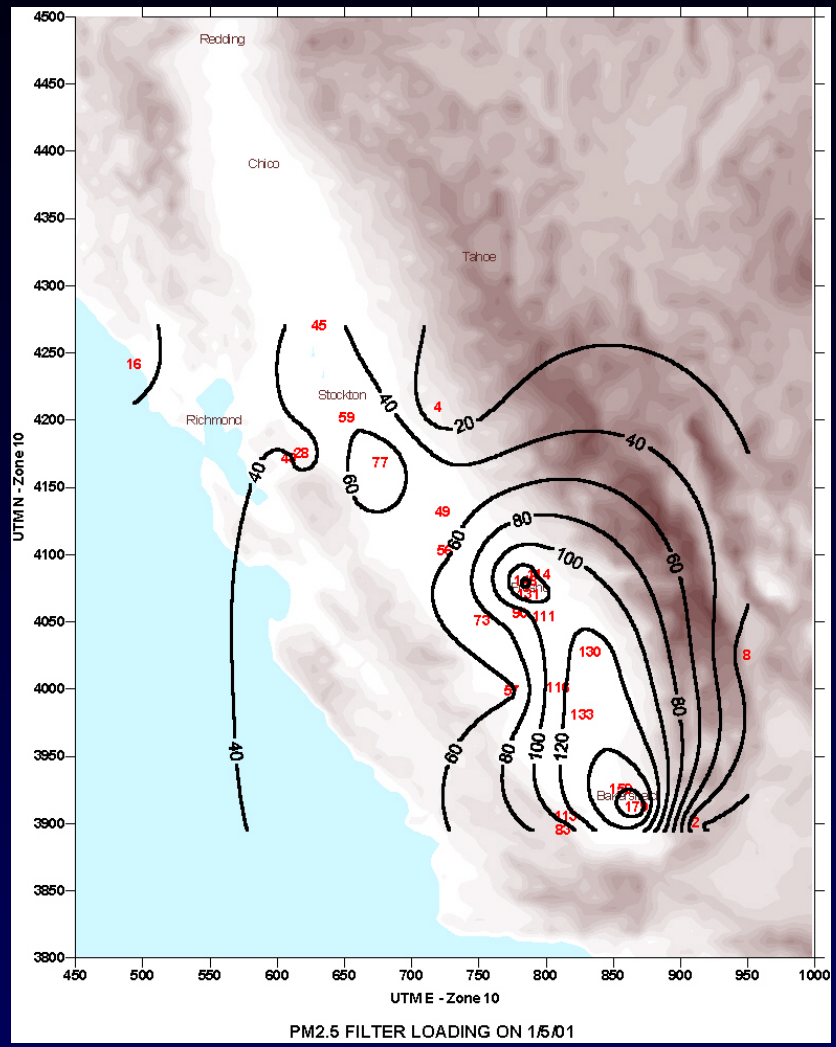

T&B Systems

## Spatial and Temporal Extent of Fogs

- Extent of fog varied significantly between IOP's
- And varied daily within episodes even more
- High particulate loading was not associated with high RH – in fact the following maps suggest the opposite

# January 5, 2001

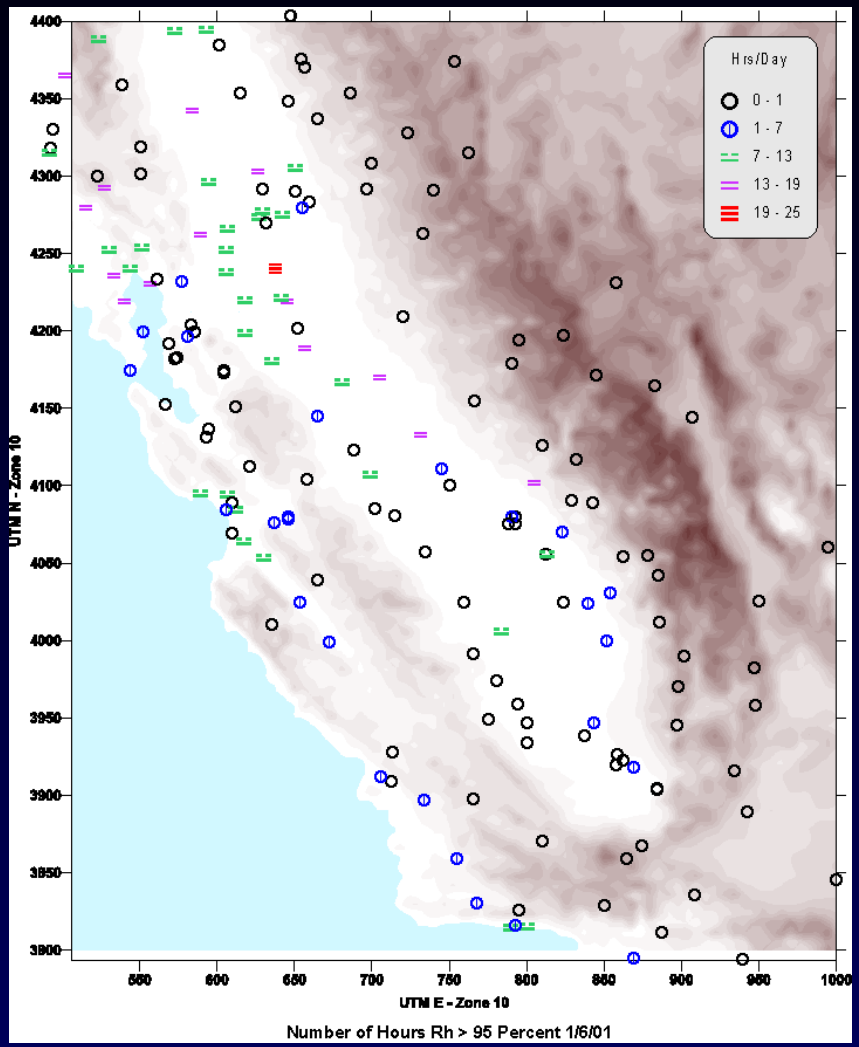


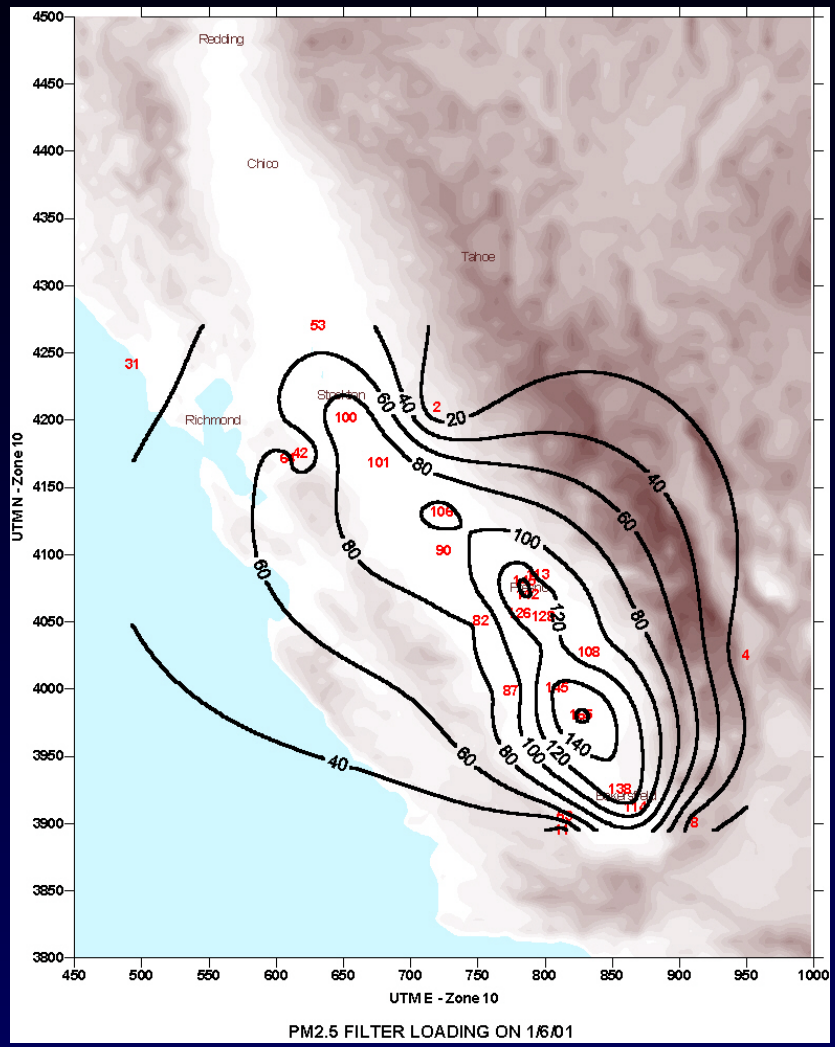



T&B Systems

# January 6, 2001



Number of Hours Rh > 95 Percent 1/6/01

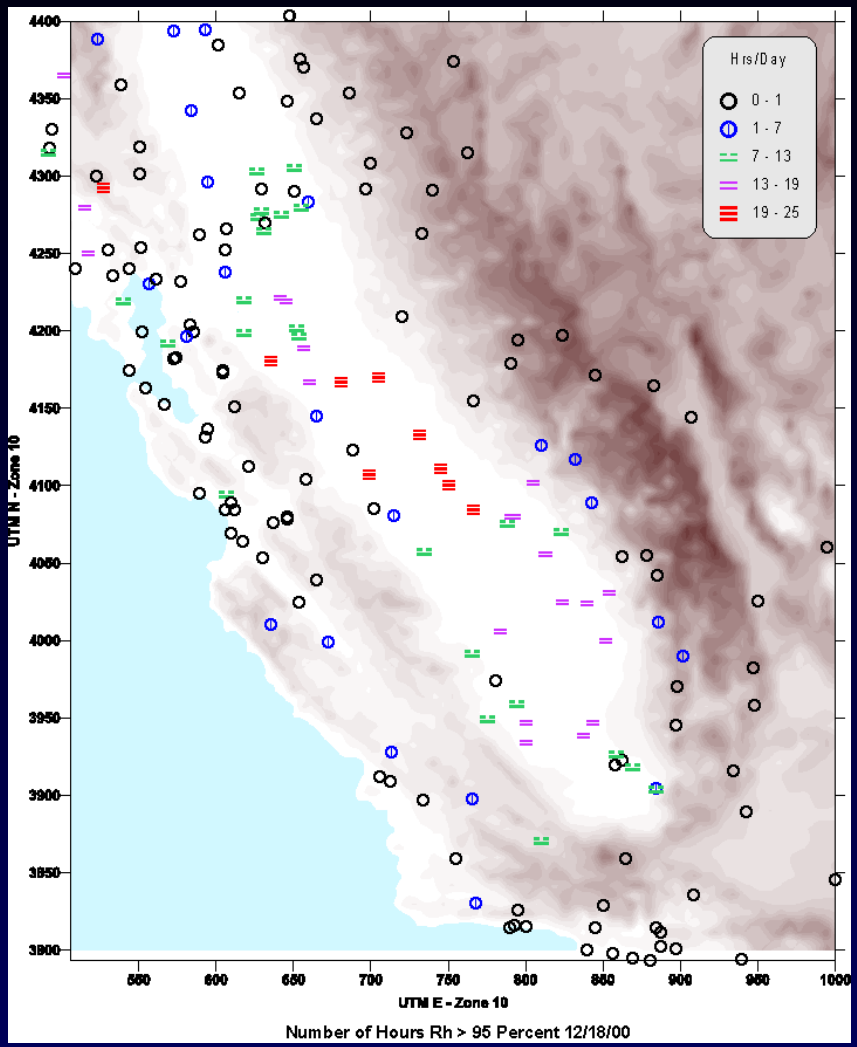


PM2.5 FILTER LOADING ON 1/6/01

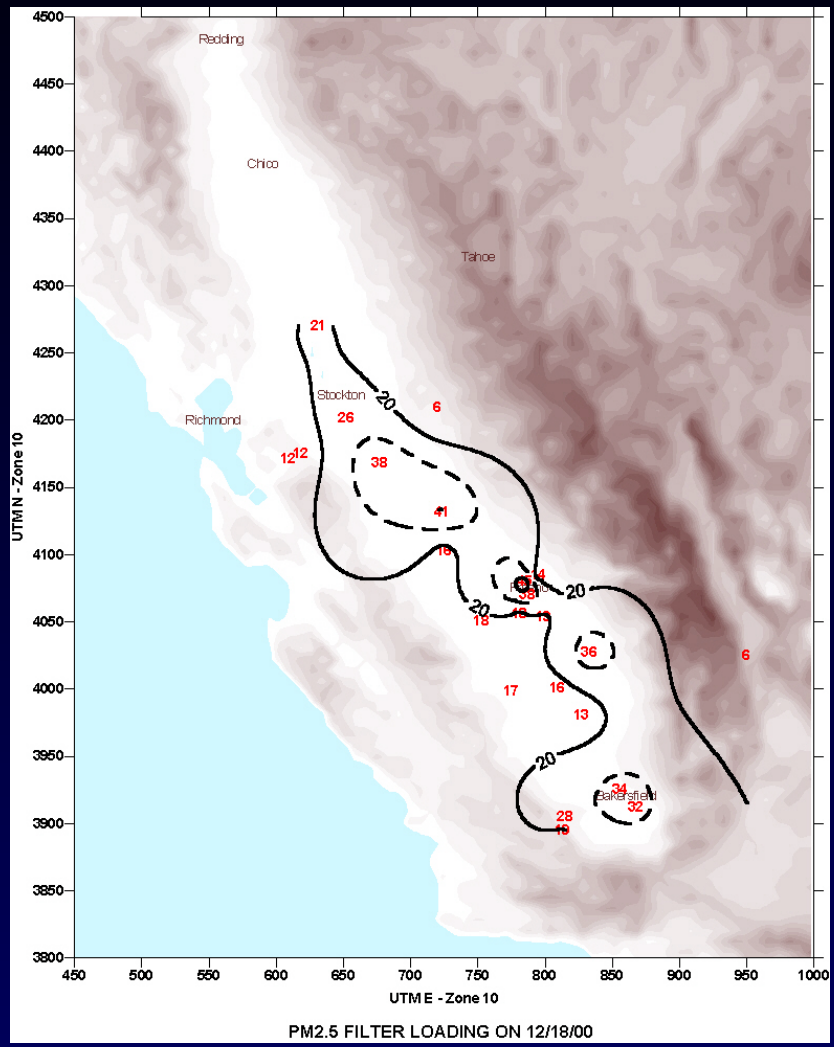


T&B Systems

# December 18, 2000



Number of Hours Rh > 95 Percent 12/18/00



PM2.5 FILTER LOADING ON 12/18/00



T&B Systems

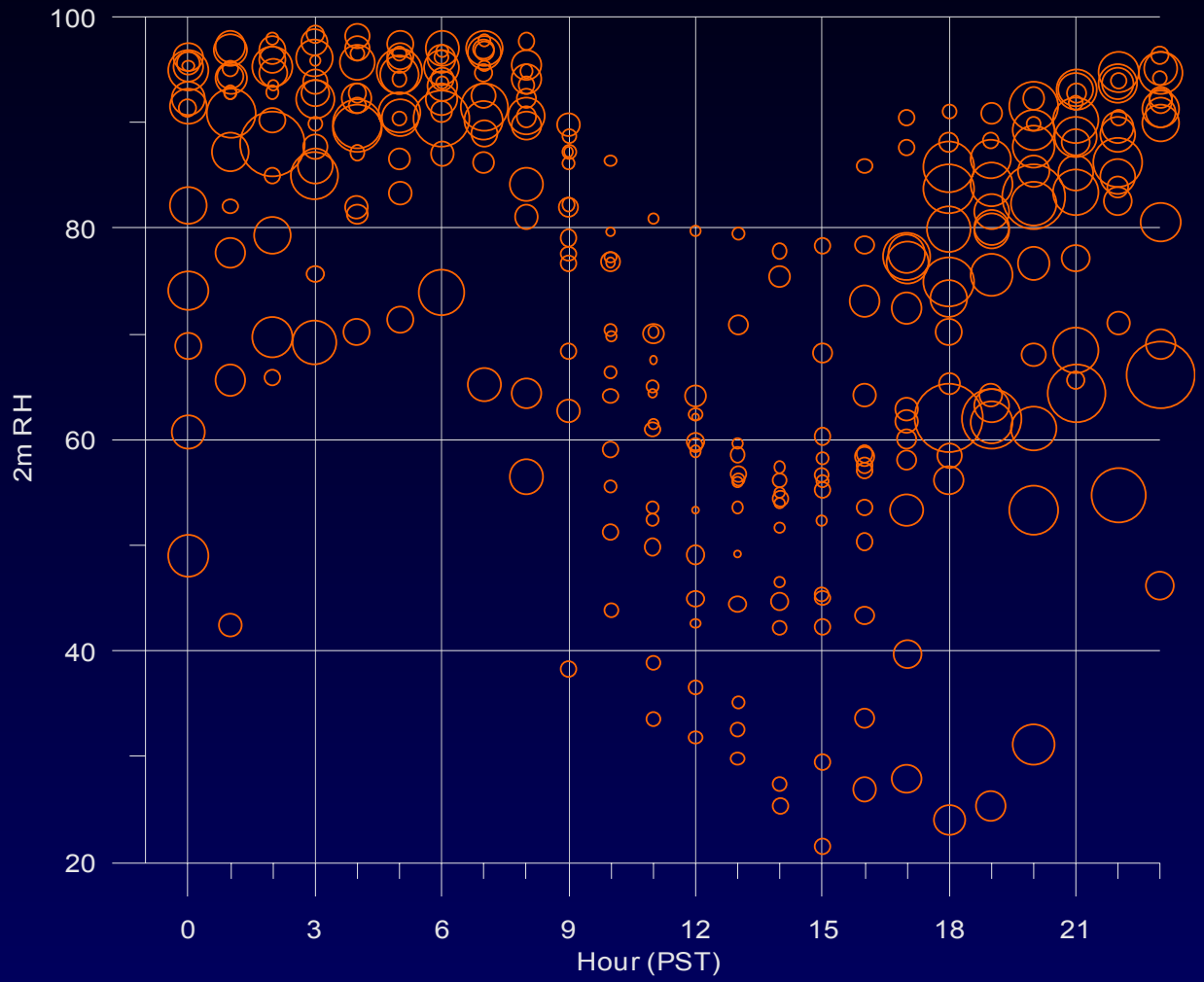
# Vertical Structure of RH (near the ground)

NOAA Collocated RH at 2 and 10 meters

- Initially investigated to define the uncertainty in RH measurements when sensors, calibrations, and procedures are identical

- The actual vertical gradient of RH near the ground was much greater than anticipated due to nocturnal inversion

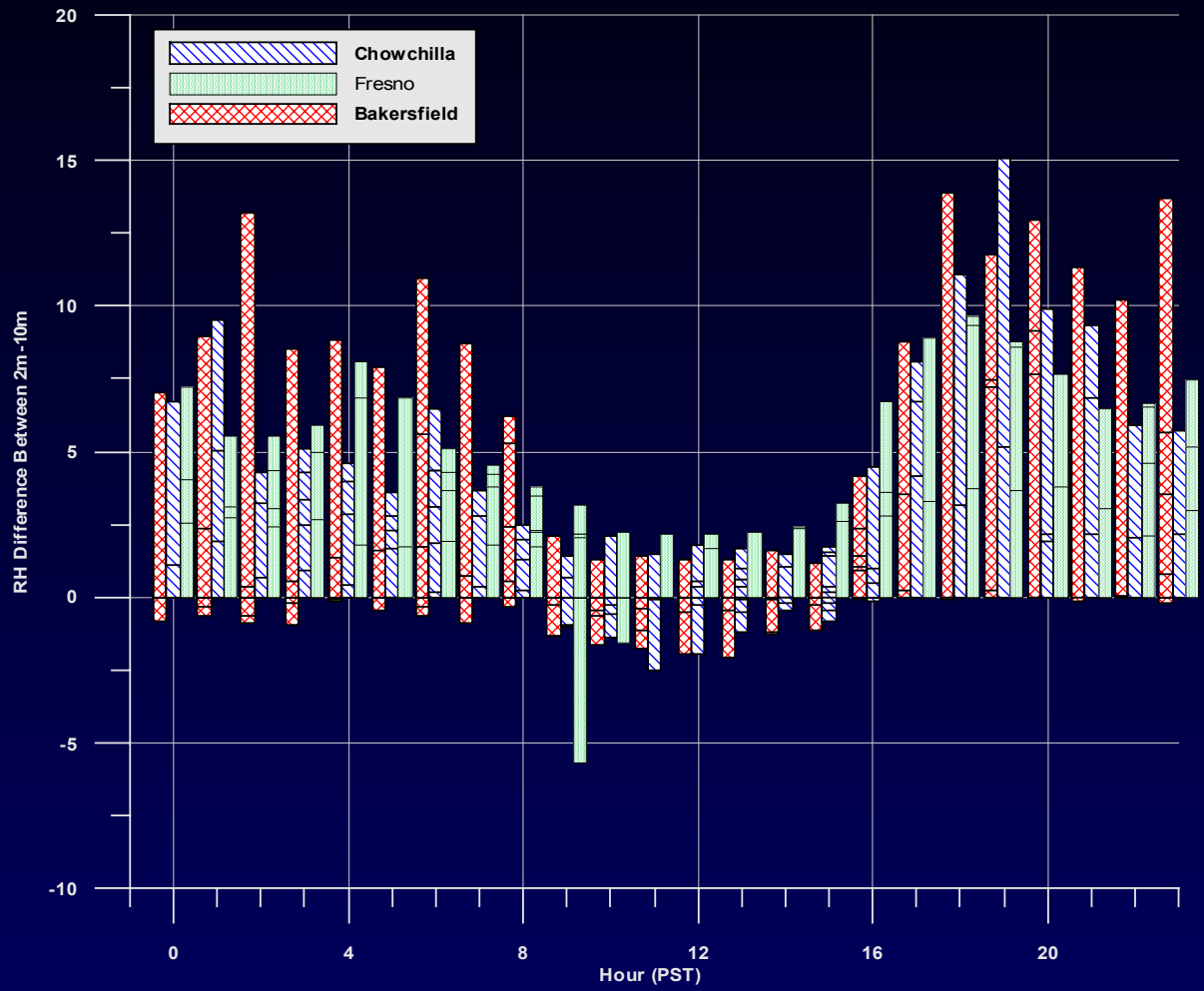
# Showing Diurnal Rh Difference Between 2m and 10m Levels
## Bubble diameter is proportional to difference
## (Note: range is from -2 to 13%) Episode 8 at Bakersfield






T&B Systems

# Showing RH Difference Between 2 Meter and 10 Meter Levels
# Episode 8 - Hourly readings at the 3 NOAA Sites in the SJV






T&B Systems

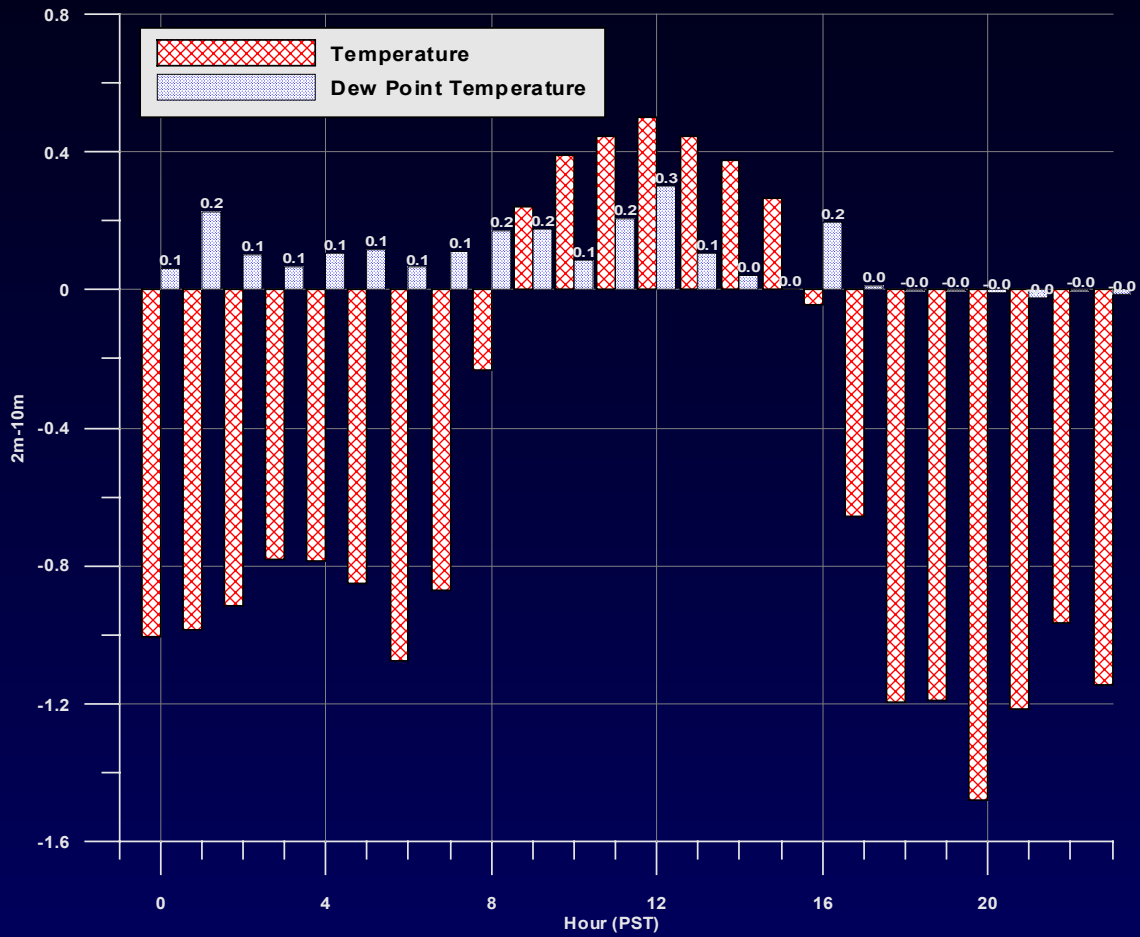
# PM Loading Model Sensitivity to RH

GFEMD Model Output

| RH (percent) | PM (µg/m3) |
|---|---|
| 95 | 9.80 |
| 94 | 9.36 |
| 93 | 9.02 |
| 92 | 8.75 |
| 91 | 8.53 |
| 90 | 8.36 |
| 85 | 7.86 |
| 80 | 7.65 |
| 75 | 7.54 |
| 70 | 7.45 |
| 65 | 7.44 |

Input: T-298?K, Nitrate = 3, Ammonia = 3, Sulfate = 5, Sodium = 0, Chlorine = 0 (units µg/m3). Source: Robinson, 2003

# Showing Temperature and Dew Point Difference Between 2 Meter and 10 Meter Levels
# Episode 8 - Average at Bakersfield for Period of Episode






T&B Systems

# Summary

## Fog maps were created for

- Average # hrs/day RH > 95% during each IOP
- Daily # hrs RH > 95% for IOPs (CRPAQS field study)
- Average # hrs/day RH > 95% during each of the 9 episodes (12/99 to 02/01)

## RH vertical gradient is large near the ground

- Operators mount sensor at varying heights above ground
- Particle mass calculations are very sensitive to RH
- Recommend a more conservative humidity parameters (e.g. dew point temperature, absolute humidity) be used)